Biological Sampling Procedures

All juvenile fish captured were anesthetized with tricaine methanesulfonate (MS-222) prior to processing. Up to 30 individuals of each species and developmental stage (young of the year, and smolts; based on size) were randomly subsampled (biosampled) from the daily catch. Biosampled salmonids were measured to the nearest mm fork length (FL), weighed by volumetric displacement (fish over 100 mm), and examined for developmental stage, fin clips, and physical irregularities. All captured salmonids that were not biosampled were tallied by species, development stage and examined for fin clips.

Fish other than Chinook salmon, coho salmon, or steelhead were considered non-target species. Non-target fishes captured were identified to species (or genus in some cases), enumerated, and up to 30 specimens were measured to FL. Total length (TL) was measured on species without a forked caudal fin. All anesthetized fish not retained were allowed to resuscitate in buckets of ambient river water before being released downstream of the trap. NovAqua® water conditioner was added to recovery buckets to help protect fish during handling, minimize infection, reduce stress and aid in recovery. Adult salmonids were not anesthetized. Fork lengths of adult salmonids were either measured or approximated before release. Any salmonid mortality in the live box was checked for a fin clip and, if included in the subsample, measured. If a salmonid escaped during netting or handling before it could be identified to species or checked for a hatchery mark (i.e. fin or maxillary clip), it was counted in the sample tally as an "unknown". Based on the probability of occurrence, unknown fish were redistributed into the most likely marked or unmarked species categories.

When present, daily subsamples of marked hatchery Chinook salmon were collected. A missing adipose fin (Ad-clip) was the external marker depicting Chinook salmon with a coded wire tag (CWT) embedded in the snout. A maximum of five hatchery Chinook salmon were collected daily. Ad-clipped fish were sacrificed for subsequent CWT retrieval. Collected fish were stored in a freezer until time of dissection. Occasionally, Ad-clipped fish were also collected for disease sampling, after which the CWT's were removed.

Juvenile Chinook salmon were classified as age-0+ (young-of-year) or age-1+, based on size and date of capture. Coho salmon were classified as either age-0+ or age-1+; the latter of which were much larger in size, silvery, and lacked distinct parr marks. Steelhead were also classified by age classes based on size and scale analysis. Scale samples were collected from a subsample of steelhead for age analysis. Fish were assigned an age based on the number of annuli (overwinter period) present. A fish with one annulus was classified as age-1+, two annuli designated as age-2+, etc.

Hatchery and Natural Stocks Estimate

Captured Chinook salmon and coho salmon were categorized as being either of hatchery or natural origin, based on size, hatchery marks, and hatchery release data provided by TRH and IGH. The California Department of Fish and Game (CDFG) coded wire tagged and Ad-clipped natural Chinook salmon from the upper Trinity River as part of their natural stocks assessment program. Natural fish are defined as the progeny of river or tributary spawning adults regardless of parental origins. Hatchery release strategies for

Chinook salmon consist of fingerling (age-0+) releases in the spring and yearling (age-1) releases in the fall. These two distinct release periods prompted the division of the trapping season into spring and fall monitoring periods. The spring monitoring period was designated as JW 1 through 39 and the fall period 40 through 52.

Chinook

All Ad-clipped fish collected were passed through a magnetic field detector manufactured by Northwest Marine Technology® to determine the presence or absence of a CWT. The snout of each fish that registered positive for a tag was dissected until the CWT was recovered. Each fish registering negative for a tag had its head dissolved in a solution of potassium hydroxide. A magnet was then stirred through the resultant slurry. If the tag was not recovered, the fish was considered an Ad-clipped fish that had shed its tag (No-Tag). Recovered tags were decoded using a dissection microscope. CWT recoveries were summed by specific CWT code for each JW.

The number of CWT fish captured for each code was estimated by multiplying the number of CWT's recovered by an expansion factor (E) which accounts for all subsampling, CWT's that were lost during dissection, and unreadable tags. The expansion factor (E) was calculated using the formula:

$$E = (C/MS)(Ad/H)(T/TR)$$

Where, C = Total # of Chinook captured,
MS= Number of fish examined for Ad-clips,
Ad= Number of Ad-clipped fish observed,
H = Number of Ad-clipped fish collected,
T = Number of collected Ad-clipped fish containing a CWT,
TR= Total number of CWT's recovered and decoded after processing.

To account for unmarked hatchery fish in the catch over a JW, the expanded estimates for each CWT code were multiplied by a production multiplier (PM) specific to each CWT code. Each PM was calculated from hatchery release data (Pacific States Marine Fisheries Commission, 2003), using the following formula:

$$PM = \frac{\#\text{ Tagged} + \#\text{ Poor Tagged} + \#\text{ Unmarked}}{\#\text{ Tagged}}$$

Where: # Tagged = The actual number of Ad-clipped fish released with a CWT,
Poor Tagged = The number of Ad-clipped fish that were tagged and shed the tag (No-Tags),
Unmarked = The number of unmarked fish in a release group.

The estimated contribution of hatchery fish attributable to a specific CWT code for a given JW, was calculated by the following formula:

$$\#\ \text{Hatchery}_{\text{code i}} = (\#\ \text{recovered}_{\text{code i}}) * (E_{JW}) * (PM_{\text{code i}})$$

The total weekly estimated hatchery contribution to the catch was the sum of all estimated hatchery fish attributable to CWT codes. The weekly contribution of naturally produced Chinook to the catch was estimated by subtracting the estimated hatchery contribution from the total weekly catch. Occasionally, the daily estimated hatchery contribution exceeded the total daily catch. In such instances the estimated hatchery contribution was limited to the actual daily catch.

Towards the end of each emigration period, due to relatively few fish passing by the trap, it is possible that we captured juveniles of hatchery origin not represented by Ad-clipped fish. If no hatchery fish captured within a given time period were marked, the hatchery contribution for that period could not be differentiated from the natural component. Thus, all fish captured during that period were considered of natural origin. The hatchery and natural stock estimates assume no differential mortality between tagged and untagged fish of the same release group, equal vulnerability to capture and accurate estimates of the numbers of marked, unmarked and poor tagged fish released from the hatchery. The estimate does not account for Ad-clipped or non-Ad-clipped hatchery fish removed from the river upstream during other juvenile monitoring operations.

Coho

All hatchery coho released in 2001 were marked with a maxillary clip (TRH coho received a right maxillary clip and IGH coho received a left maxillary clip). The weekly contribution of naturally produced coho to the catch was estimated by subtracting the actual hatchery contribution (marked fish) from the total weekly catch.

Abundance Index

Catch effort data were recorded and evaluated for each sample day. Trends in emigration were analyzed on a JW basis using weekly abundance indices, adjusting for days not sampled (occasionally woody debris or an accumulation of aquatic vegetation would cause the cone to cease rotating). Daily abundance indices (Index_d) for each species and development stage were calculated by the following equation:

$$\text{Index}_d = \text{Catch}_d / (Q_s/Q).$$

Where: Catch_d = daily catch of a species
Q_s = volume of water sampled (cfs)
Q = mean daily river discharge (cfs)

Weekly abundance indices were calculated for each JW using the following equation:

$$\text{Index}_{JWi} = \Sigma\text{Index}_d\ (\#\ \text{days in } JW_i / \#\ \text{days sampled during } JW_i)$$

The usefulness of this index as an estimator of abundance is contingent upon the assumptions that catch rates are directly proportional to the percentage of river flow sampled and that individuals from a given species are equally susceptible to capture. The abundance index is not intended to represent a population estimate but is used to compare relative abundance between weeks during the trapping season, between trapping seasons, and between years.

Abundance indices were calculated for the more abundant non-target species in the same manner as was done for the salmonids. As with the salmonids, validity of this abundance index is contingent upon the assumption that catch rates are directly proportional to the percentage of river flow sampled. For fish emigrating downstream, such as the salmonid smolts, this assumption seems reasonable. However, this may not be the case for other species that are not actively emigrating, or for fish that preferentially use different parts of the river.

Migration Rate

Initial migration rates for hatchery Chinook and coho were estimated by dividing the distance (rkm) traveled by the number of days elapsed between the initial release date and initial capture date for specific CWT codes or marked fish. Due to prolonged volitional releases practiced by TRH and IGH, mean migration rates could only be estimated for IGH Chinook releases.

Daily migration rates were weighted by the proportion of river flow sampled to reflect the untrapped fish passing through the sampling area. A mean migration rate per CWT code or marked fish was calculated by the following formula with the first 10% and last 10% of each group excluded:

$$Rate_{mean} = \frac{\sum \left(\# * \frac{rkm}{d} * \frac{Q}{Q_s}\right)}{\sum \left(\# * \frac{Q}{Q_s}\right)}$$

Where # = Daily expanded CWT_i code or fin clip counts,
rkm/d= distance traveled divided by number of days taken to reach trap after initial release,
Q = mean daily volume of river discharge ,
$Q_{S=}$ volume of river discharge sampled.

The 10 through 90 percent capture dates were used to calculate the migration rate of the majority of each specific CWT or mark group. When less than ten tags of any specific release group were recovered all tags were used. Ad-clipped Chinook not collected (i.e.; released at time of capture) were included in migration rate calculations using tag allocation procedures previously described in the hatchery and natural stocks estimation section of this report (page 8).